AGRICULTURAL Research

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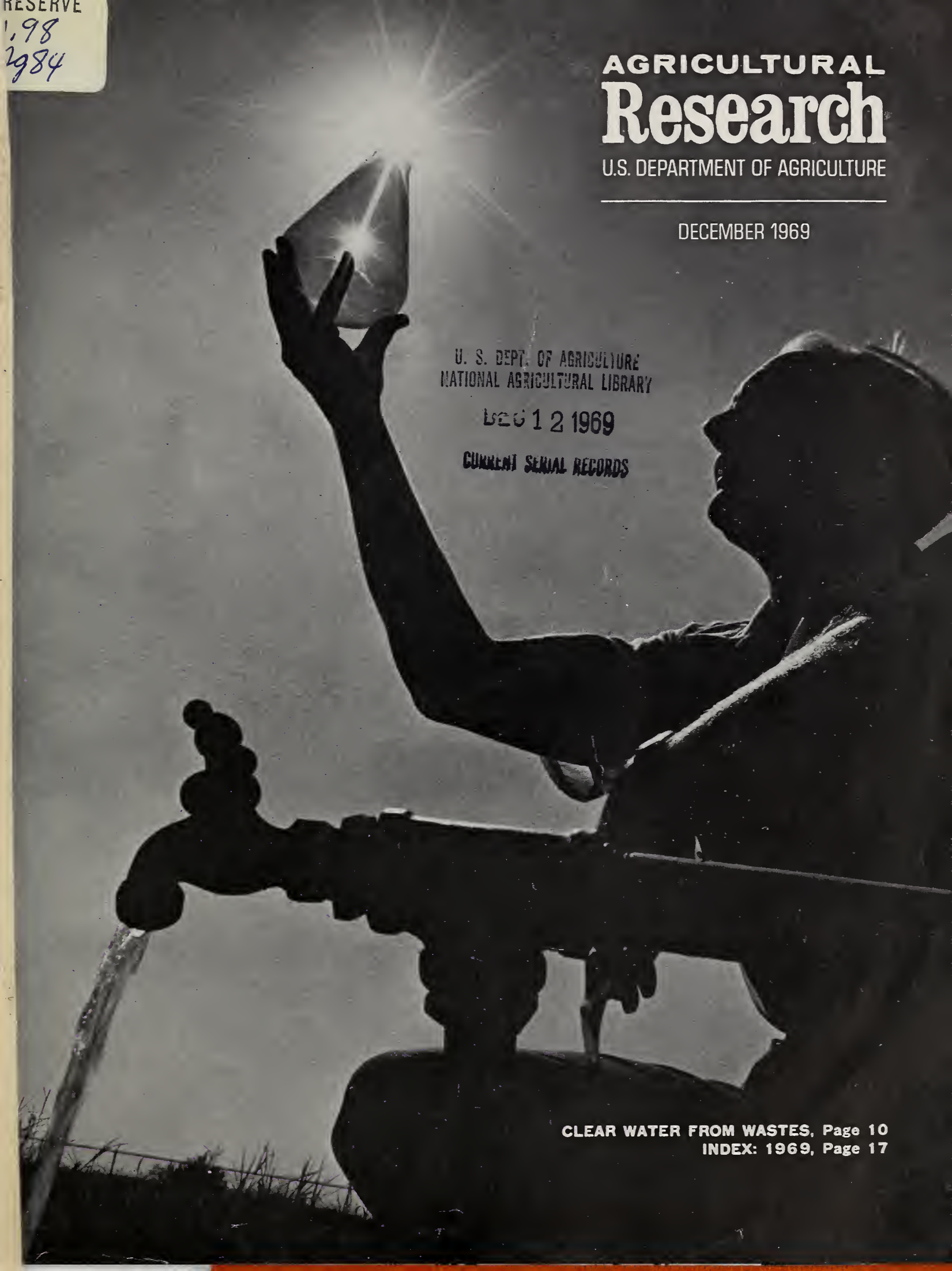

AGRICULTURAL
Research

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Food for Us All

Agriculture has wrought a miracle of plenty in the three centuries since that hungry and bleak winter which tested the Pilgrims in a new land.

Today our supermarkets teem with such an array of foods that shoppers are often faced with delightful indecision. Yet malnutrition and undernutrition linger in our affluent society. Many Americans are too poor to buy an adequate diet. Others lack even an elementary knowledge of nutrition. If people are to do their best and give their best, they must be properly nourished.

This vital, basic need is the theme of the latest Yearbook of Agriculture *Food for Us All.* Its 400 pages provide a storehouse of information for those who would feed their families nutritiously and economically. In the foreword, Secretary of Agriculture Clifford M. Hardin also expresses the hope that the new Yearbook will "be a useful gadfly to the American conscience," one to "whet the appetite of every reader for action in achieving the goal of *Food for Us All.*"

The Yearbook contains 46 chapters, rigorous in scholarship and accuracy yet written in popular language. *Food From Farm to You,* the first section of the book, describes the economics of food, from farm and sea to check-out counter. The second section, *Buying and Cooking Food,* covers the major classes of food such as meats and vegetables through the art of using spices and herbs. Many buying tips and recipes are also presented. The last section, *Food and Your Life,* is devoted mainly to nutrition and the planning of meals. Topics discussed include basic food needs, creating good food habits, weight reduction, and ideas for stretching food dollars.

ARS scientists are among the contributors to this Yearbook. *Food for Us All* should be a welcome ally in the nutrition education efforts being waged around the country by nutritionists of ARS and other agencies. The facts and figures marshalled here can help make a significant impact in improving our national well-being. But to reach this goal it is ultimately up to each of us to choose foods wisely at the store and table.

Copies of the 1969 Yearbook *Food for Us All* may be purchased for $3.50 each from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Members of Congress have a limited number of copies for free public distribution.

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

the search for chemical triggers

IN THIS DRAMATIC AGE, the exploration of outer space sometimes makes one forget the dramatic and important exploration of inner space—occurring right here on earth.

The search for the reasons why plants develop in the ways they do, for instance, has been of continuing interest. What makes some plants taller, what makes some drop their leaves in the fall, what makes plants flower and set fruit at certain times of the year? All these questions and others are barely beginning to yield to man's search into the fascinating world of growth-regulating substances of plants, or plant "hormones," as they are sometimes called.

As recently as 1928, F. W. Went, a famous American botanist of Danish origin, developed a method for obtaining the first plant hormone, a substance responsible for causing plants to bend toward light. He named the substance "auxin."

In the past four decades since, the drama has been unfolding slowly with the isolation and identification of several other families of plant growth regulators—for example, the gibberellins which cause plant stems to elongate and the kinins which cause cells to divide.

On the practical side, these regulating hormones have been of use to agriculture in many ways—in stimulating root formation on cuttings, in keeping stored potatoes from sprout-

Technician M. E. Drowne passes a jet of hot air into a small flask to evaporate the solvent containing the condensation products with hormone-like properties (ST–5368–2).

ing, in producing seedless fruits—to mention only a few.

The most recent episode in the drama unfolded in the laboratory of ARS plant physiologist J. W. Mitchell at Beltsville, Md.

Mitchell, along with ARS chemists N. Mandava and J. R. Plimmer, plant pathologist J. F. Worley, and technicians M. E. Drowne and B. A. Sidwell were testing plant hormones extracted from pollen when they noticed some startling results in the bean seedlings used in their tests. Substances not expected to cause stem elongation in the seedlings were causing them to elongate as much as those in a group of hormone-treated plants.

This unexpected event triggered a search for the activating substances. After many months of searching and testing, two substances finally emerged—phorone and triacetonediol—both condensation products of acetone and both rather unstable. Their very instability is a phenomenon that may merit further exploration.

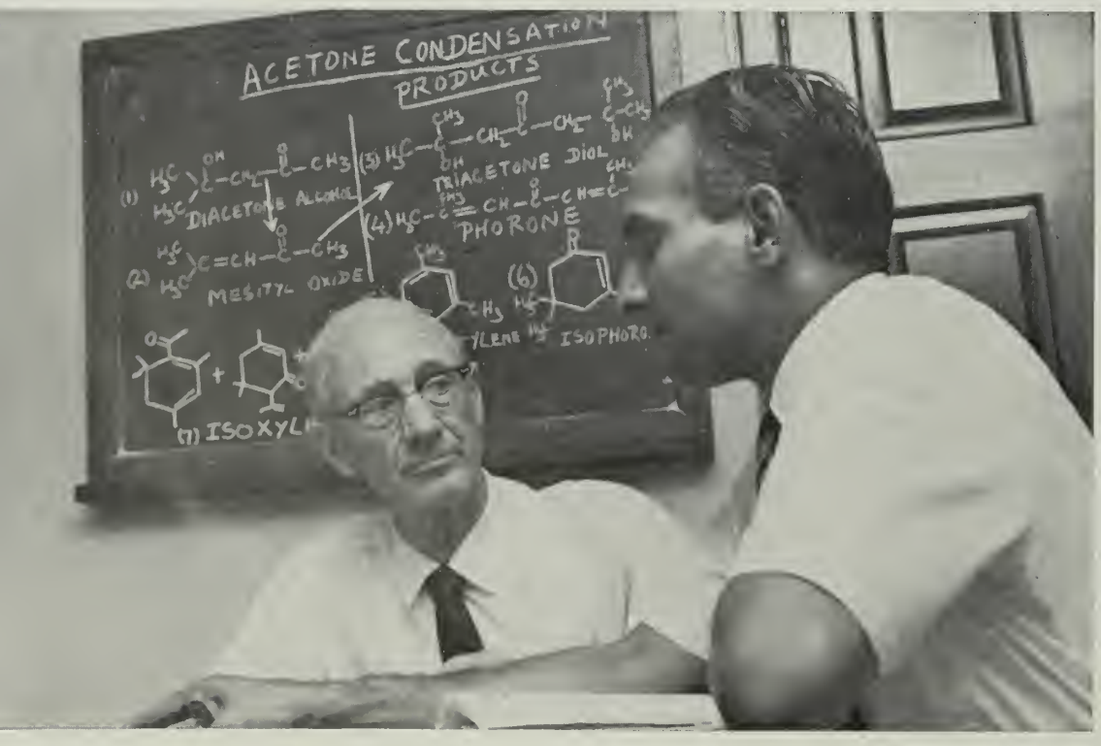
Both these condensation products, when applied to stems of bean seedlings in minute amounts, cause marked stem elongation—and about the same amount of elongation as that caused by the same amount of gibberellin.

Although the growth-stimulating effects resemble gibberellin, as far as the new substances have been tested, their molecular configurations and complexities are entirely different. Thus, phorone and triacetonediol represent an entirely new family of plant growth regulators.

Even though it is yet too early to predict all the practical implications of this recent discovery, one advantage immediately apparent is that these chemical substances are available commercially and can be purchased should further testing prove their practical significance.

In the meantime, investigating and testing continues. ■

Above: Bean plant at left was treated only with lanolin; center plant was treated with 5 micrograms of gibberellin and lanolin and plant at right, with 5 micrograms of phorone and lanolin (PN–1833). ***Below:*** *Mitchell and Mandava discuss possible structures of the condensation products of acetone (ST–5367–2).* ***Right:*** *A minute amount of phorone is applied to the second internode of a test bean seedling (ST–5368–32).*



wool & mohair

modified for smoother performance

Thorsen examines treated mohair fibers as they emerge from the corona reactor (PN–1832).

EXACTLY WHAT HAPPENS to wool or mohair fibers in the 2 or 3 seconds they are in there isn't fully known, but when they come out they have some desirable properties they didn't have when they went in.

Textile chemist W. J. Thorsen stands at the output end of a corona reactor, a device built at the ARS Western utilization research laboratory to chemically modify wool and mohair fibers by passing them through the atmosphere between two electrically charged plates.

He hands you a tuft of mohair that has just been conveyed through the pilot-scale reactor. Although you are no fiber expert, you can tell at the instant of touch that treated fibers are considerably less slick than untreated fibers.

Slickness in untreated mohair fibers (the hair of Angora goats) makes them difficult to handle during carding, spinning and other processes involved in converting raw fiber into finished fabric. Slickness is a major obstacle to increased use of this natural fiber.

Other improvements in the chemically modified fibers are shrink and soilage resistance. Under proper control, corona treatment does not change fiber tensile strength, fabric abrasion resistance (durability), or fiber color. The improved cohesiveness of the fiber, however, increases yarn tensile strength, and yarns may also be spun more efficiently. Fabric luster, a desirable quality of mohair, is not significantly changed.

Although treated fiber absorbs water faster than untreated and fabric made from treated fiber feels slightly more harsh to the touch, these drawbacks can be overcome by chemical treatments for fabrics developed at the laboratory.

Modifications in wool and mohair fibers are similar; the main difference is that slickness is less affected in wool fibers since they are not slick before treatment.

Fiber modification takes place between two electrode plates about five-sixteenths of an inch apart. In the pilot reactor, the plates are 14 by 24 inches. A corona field is created when the electric charge on the plates is strong enough to break down the air or gas between them into ions and free radicals. Charge reversal and gas breakdown occur 4,000 times per second at the 2,000 cycle frequency used.

Such conditions induce chemical reactions that otherwise might be caused only with difficulty and by more costly treatments. Precisely what kind of chemical changes take place in fibers during treatment is not known. But it is obvious the change is in the surface layers—the interior of the fiber is not changed.

One of the reasons the chemical reaction is difficult to determine is that the mixture of ions and free radicals (species) in the corona field is complex. With air, moisture, and chlorine present, the mixture includes at least 27 species. Among them are atomic oxygen, ozone, nitrogen oxides, and nitric acid.

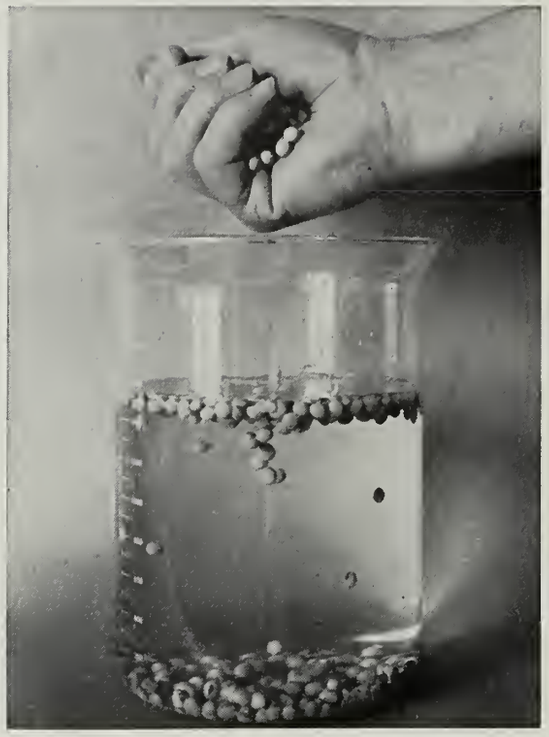
The fact that the chemical reactions occur on or near the surface adds to the difficulty of determining their nature. "We would literally have to skin the fiber to get the affected part for study," Thorsen explains.

Cost of corona treatment in a commercial plant would depend on scale of treatment. Thorsen estimates, however, that aside from cost of equipment, treating costs would be considerably less than 1 cent per pound.

"Although corona treatment is not new," Thorsen says, "there is still a lot to be learned about it. We have improved on earlier processes by adding a small amount of chlorine to the air and operating at high temperature. The changes speed up the reaction by a factor of at least 10, making the process practical now. Commercial processors are interested, and corona reactors should become available before long."

At the present stage of development, however, corona treatment appears to have more potential benefit for mohair than wool because mohair is more difficult to process and treatment overcomes some processing difficulties. ■

test measures STINKBUG DAMAGE in soybeans



Above: *In flotation method, punctured beans float because they are light (ST–4585–14).* ***Right:*** *In density method, device measures time bean takes to fall from one point to another. Bean breaks light beam at each fixed point. Information registers on computer, is fed to tape punch, and processed by computer. Slightly more accurate than the flotation method, it's more expensive and complex (ST–4585–25).*

MORE ACCURATE, faster methods for assessing stinkbug damage in soybeans have been developed by ARS to help give farmers and buyers a better idea of their product's market value.

Stinkbugs puncture the green pods of growing soybeans, sucking the sap out of the beans and exposing them to further mold, fungi, and yeast damage. A problem in soybean-rich southern States, puncturing can lower the oil content of a soybean by as much as 2 percent and raise oil refining costs. Present control measures are only partly effective.

Buyers now discount the price of a lot containing damaged beans according to the percent by weight of damaged beans. A bean with 10 punctures generally weighs less—and yields less oil—than a bean with one puncture. But under the present examining system, buyers pay more for a lot containing a certain percentage of heavily damaged beans than for a lot containing the same percentage of slightly damaged beans.

ARS chemist J. R. Hart devised two new tests that show the actual amount of damaged tissue in the soybean sample rather than the weight of damaged beans. The tests have not yet been field tested.

His "flotation method" involves counting the beans that will float in a saturated solution of sodium chloride. The percent of floating beans within a given sample is related to the amount of stinkbug-damaged tissue.

The "density method" measures the time it takes for individual beans to fall from one fixed point to another through a vertical column of water. Beans will fall faster or slower depending on the amount of damaged tissue they contain.

Results of these tests are available to the buyer within 15 minutes—more than 30 minutes sooner than with the presently-used method.

Both methods give accurate results, especially if split, moldy, misshapen, and shriveled beans not containing punctures are picked out of the sample.

A grain inspector or buyer with limited technical training could test samples easily and inexpensively with the flotation method.

The density test, while slightly more accurate, is more complex and requires expensive equipment that is not readily available commercially. Instrumentation for the density test was developed by ARS agricultural engineer J. D. Rowan in Beltsville, Md. ■

fats linked to goiter

LACK OF SUFFICIENT IODINE in the diet coupled with intake of certain fats can trigger the development of enlarged thyroids, a diseased condition called goiter.

This finding, by Columbia University scientists working under an ARS contract, could be significant in iodine-deficient areas where the decreased use of iodized salt is believed to be an important factor in the increasing occurrence of goiter. Another contributing factor involves such new developments in food processing as the continuous mix bread process, which call for salt that has not been iodized.

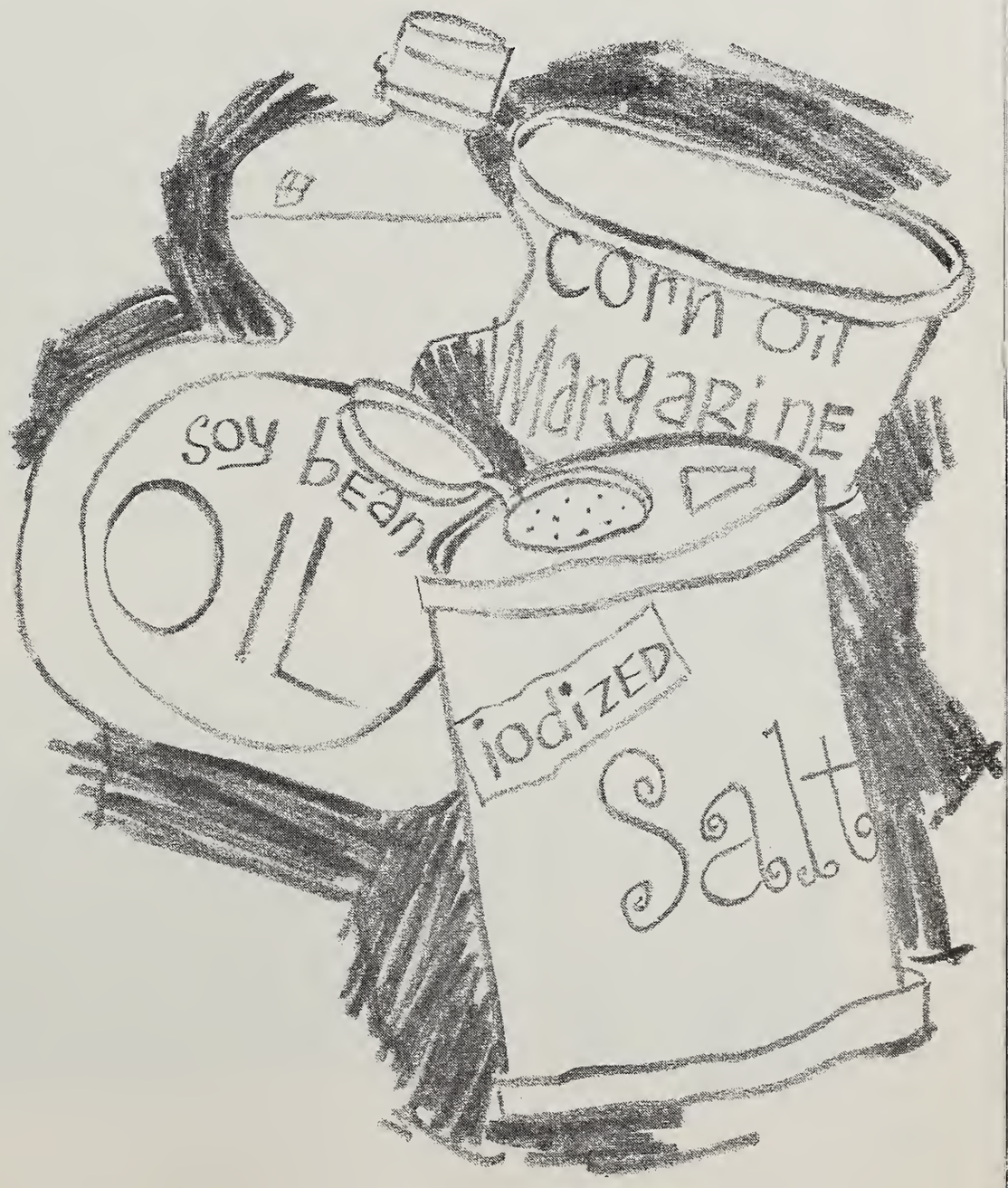
In the study, male rats of the Columbia-Sherman strain were fed an iodine-deficient diet containing 20 percent fat by weight plus a weekly vitamin supplement. The fats, which had been prepared for human consumption, varied only in type: fresh and mildly oxidized beef fat, chicken fat, butter, lard, cottonseed oil, olive oil, corn oil, or soybean oil. Other rats of the same strain were given a commercial ration. All received the diets from the time of weaning until spontaneous death except for the control animals which were sacrificed at 18 months.

In contrast to normal-size thyroids of 23 to 31 milligrams found in the control animals, thyroids in the experimental rats ranged from 34 to 1,217 mg. Olive oil in the diet produced a high incidence (78 percent) of thyroids weighing more than 100 mg. The incidence of large thyroids was low (22 percent) when the diets contained butter, pork, or beef, while chicken fat, soybean oil, and corn oil were intermediate (49 percent) in their effect on the size of the thyroid.

Iodine content of the thyroids analyzed was similar for all groups receiving fat in an iodine-deficient diet. This finding, together with the fact that significantly more thyroids weighing over 100 mg. were found in rats fed vegetable oils, led to the conclusion that the increased thyroid size was caused by goiter-producing substances in vegetable oils rather than by increased iodine requirements of the rats. The incidence of large thyroids was the same for groups fed fresh and oxidized vegetable oils, indicating that mild heating and oxidation did not destroy these goiter-producing substances.

Because there were more thyroids weighing less than 100 mg. in all age groups fed animal fats, advancing age of the experimental rats was ruled out as a significant factor.

Thirty percent of the animals 600 days or older were found to have pituitary tumors. The percentage of tumors occurring in rats with heavy thyroids was lower in those fed vegetable oils, although the overall tumor incidence was the same as in rats fed animal fats. Whatever the cause of the increased incidence of large thyroids among animals fed vegetable oils, the substances responsible did not appear to affect the number of pituitary tumors. ■



WANTED

TAGS with stay power

EAR TAGGING, the most common way to identify livestock both on a permanent and temporary basis, has two disadvantages—tags are easily lost or they become illegible. To eliminate these problems, ARS animal identification specialist N. W. Hooven, Beltsville, Md., is evaluating several types of tags.

Showing promise for identification of sheep and lambs, for example, is a new tag made of an oilcloth-like material that is light in weight and yet large enough to be easily seen from a distance. The tag is shaped like a barbell, except that the ends are flat and square. The lamb's nursing ability is not affected by this ear tag as it is with heavier tags. The tag is also being tested on calves and older cattle.

Another ear tag under evaluation is made of a lightweight, flexible plastic. One end is square and contains the identification number; the other, shaped like an arrow, is punched through the animal's ear with a specially designed tool. In 1-year tests with beef cattle, this tag had about 98 percent retention as compared with some other tags which had only about 77 percent retention.

A high level of retention is also found with a plastic tag which is held in place by a four-pointed, star-like projection at the back of the tag.

Another type, the brisket tag, can be easily seen, says Hooven, and none of them have been lost by cattle. But this tag is expensive and hard to insert because of the thick skin in this region of the body. Since the tag passes through two folds of skin, infection is more likely to develop and be more difficult to treat than infection from ear tags.

When dairy cattle are milked in herringbone-style parlors, only the hindquarters are visible, making neck chains and ear tags impractical for identifying animals. To help dairymen, Hooven is trying newer methods of identification which can easily be seen by the person milking the cows. One method is the "flank" tag. Unfortunately, flank tags are difficult to insert and require careful disinfection of the wound area, a time-consuming project for a busy dairyman. And the flank is continually subjected to contamination by dirt and manure, inviting infection. When the cow walks, the flank stretches, irritating the wound and thus prolonging the healing process. Additional work needs to be carried out to overcome some of these disadvantages.

Tail tags have been used by dairymen, but Hooven considers them a waste of money. If the tags are not tight, they slide off easily, especially in fly season when the tail is used as a swatter. If, on the other hand, the tags *are* tight, the blood can't circulate and the animal's tail sloughs off.

Several types of tags are also being evaluated on sheep and cattle at Clay Center, Nebr., and Front Royal, Va. ■

***Left:** Brisket tag (ST–4936–4). **Center:** Lightweight tag that is easily seen at a distance (ST–4934–9). **Top right:** Tag inserted with hollow tube has high rentention rate and is becoming popular with cattlemen (ST–4937–8). **Bottom right:** Tag held by star-like projection is not easily lost (ST–4937–24).*

Left: Hart at computer where he processed 2 years of data in about 20 hours (ST–4867–15). Right: Grass sample is collected to determine amount of forage in pasture (ST–4867–2).

MOLASSES /feed supplement for the tropics

Molasses can be an acceptable alternate to corn as a feed supplement in the tropics and other parts of the world where grass is abundant and molasses inexpensive and easily obtained, but where corn is not readily available or economically practical.

Feed supplements help grazing cattle gain faster than they do on diets of grass alone, and less pastureland is needed. Grass may provide sufficient protein, but it often lacks available energy, hence the need for supplements.

Studies to evaluate molasses as a feed supplement for cattle grazing orchardgrass were conducted over a 2-year period at Beltsville, Md., by ARS agronomists R. H. Hart and G. E. Carlson, and animal nutritionists James Bond and T. S. Rumsey.

In their experiments they pastured 116 yearlings, steers and heifers, averaging about 450 pounds each on 18 orchardgrass pastures. Pastures ranged from 1 to 3 acres and were stocked at a rate of 1½ to 5 animals per acre. Equal numbers of cattle grazed on grass alone, grass plus a self-fed corn supplement (90 percent ground shelled corn and 10 percent fat), and grass plus self-fed molasses with urea added to increase protein to 9 percent, matching the protein content of corn.

Depending on the amount of grass available, cattle that ate only grass gained about ½ to 1½ pounds a day. Those fed 9 to 11 pounds of molasses daily and the same amount of grass as cattle on grass alone gained 1 to 2 pounds a day. With a corn supplement of 9 pounds a day, the gains ran from 1½ to 2 pounds regardless of the grass available.

The highest beef production per acre in one season—1,200 pounds—was obtained from cattle fed a corn supplement. With molasses, 850 pounds was the highest gain, and without any supplement 500 pounds was the top figure.

The studies showed that gains were controlled by feed consumption and by each animal's ability to convert feed to beef. Gains among the animals varied the least when feed was limiting. When feed was not limiting, gains varied widely because of the difference in each animal's conversion ability.

Interestingly, the weight gains were not related to sex; both steers and heifers gained equally in each feeding situation.

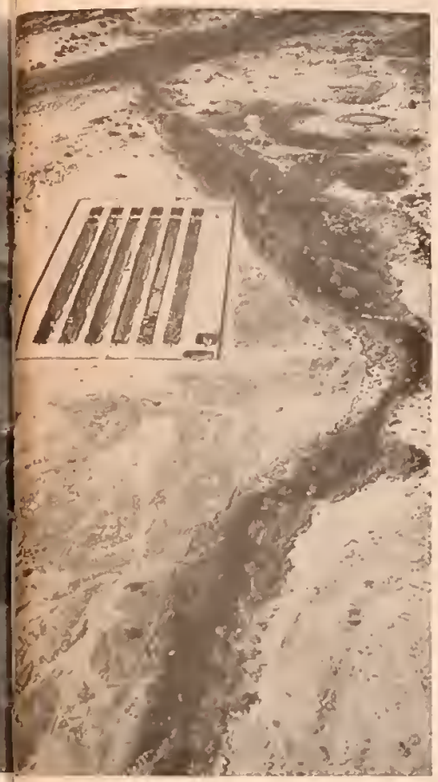
Nine heifers from each test group were graded on the hoof according to USDA standards, then slaughtered and the carcasses graded. Meat from animals on supplemented diets was rated higher than meat from those fed only grass. Seven of the corn-fed cattle were rated choice, two rated good. Of the molasses-fed group, three were choice, five good, and one standard. Eight of the grass-fed cattle rated good and one, standard.

In taste-panel tests, the meat was rated on aroma intensity and desirability, fat and lean flavor, fat and lean color, texture, tenderness, juice quality and quantity, and on overall desirability.

Meat from animals on supplemented diets was rated superior to meat from cattle fed only grass. Samples from corn-fed and molasses-fed animals were rated about the same except that the corn-fed beef was more tender. The taste panelists rated taste and tenderness the same for both choice and good grades of the corn-fed and the molasses-fed beef. The ratings of grass-fed beef covered a broad range from high to low in taste and tenderness.

In continuing research, the scientists are studying the use of molasses as a supplement with other grasses. ■

Cover: *Bouwer examines reclaimed water pumped from a depth of 30 feet. Samples for bacteriological analysis are drawn from this pump, located in the center of the project (1069Z41–7).* ***Left:*** *The Greater Phoenix sewage treatment plant provides primary and secondary treatment for 70,000 acre-feet of sewage annually. The Flushing Meadows Project is circled (1069Z43–3).* ***Right:*** *Aerial view of Flushing Meadows shows relationship of effluent channel and Salt River bed to project (1069Z43–9).*



CLEAR WATER FROM WASTES

GRASS-COVERED BASINS called plant-soil filters may be one answer to the need for multiple reuse of water.

Predictions are that multiple reuse of water will be necessary by 1980 when water consumption for all uses in the nation will equal or exceed the recoverable streamflow and ground water supply.

Soil and hydrogeologic conditions permitting, plant-soil filters can cleanse for unrestricted irrigation, recreation, or even human use 300-acre feet or more of secondary sewage effluent per year per acre of filter. And the filters could do it at a fraction of the cost of equivalent chemical treatment. Unlike chemically treated effluent, the renovated water has lost its identity as sewage effluent and has become ground water.

These are facts learned from a pilot project dubbed Flushing Meadows in the first 2 years of operation near Phoenix, Ariz. (AGR. RES., Nov. 1967, p. 4). Effluent from the sewage treatment plant at Phoenix is discharged into a dry river bed and some of the effluent is pumped into the basins for the study. The project is a cooperative effort of ARS, the Salt River Project (irrigation district), and the Federal Water Pollution Control Administration.

Cities now usually treat raw sewage to varying degrees, then discharge it into rivers. There, the nitrogen content of the effluent can be a pollution problem. Nitrogen and phosphorus promote profuse growth of algae.

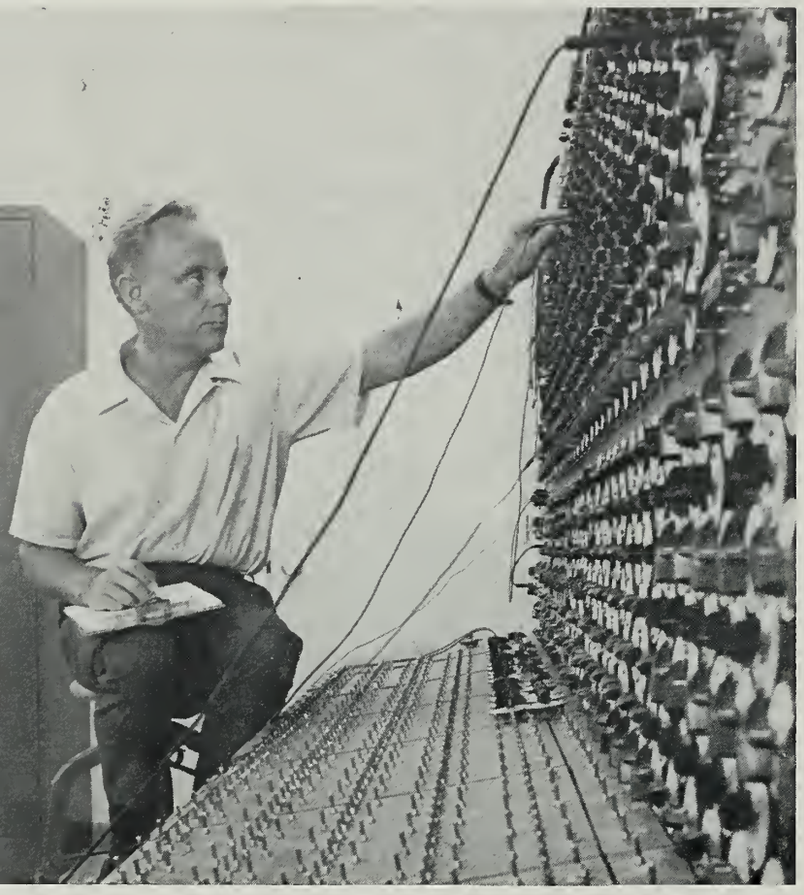
A plant-soil filter system of some 1,000 acres could handle all of the secondary effluent from Phoenix and adjacent cities—a projected 300,000 acre-feet annually by the year 2000. What's more, the reclaimed water is less costly than most water purchased from irrigation districts. Plant-soil filter costs run about $5 per acre-foot while chemical treatment runs to about $50 per acre-foot. Costs vary on water from irrigation districts but some run $10 per acre-foot or even higher.

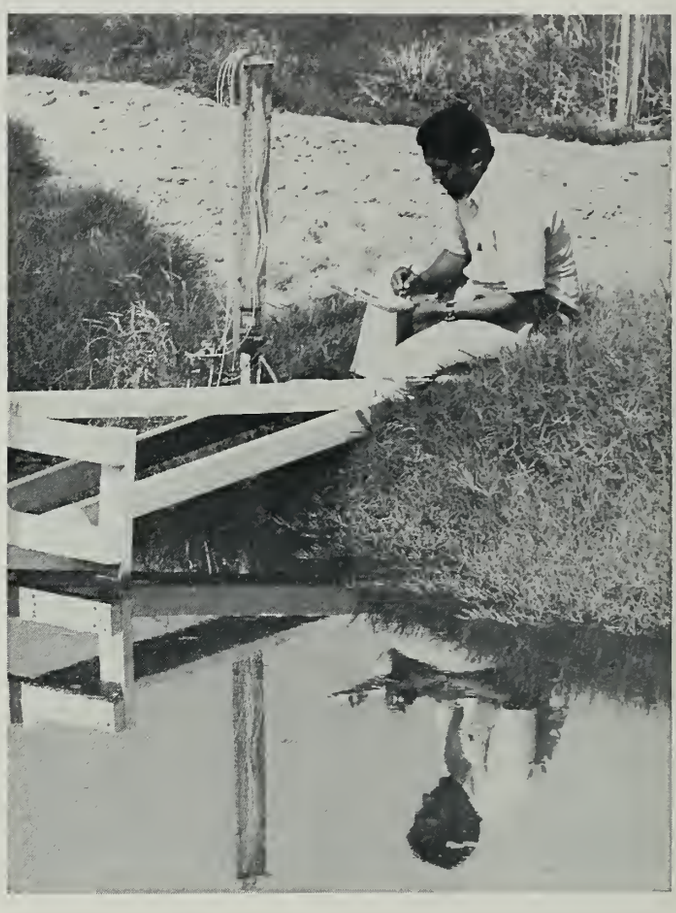
The Flushing Meadows Project

Above: Effluent is pumped from constant head tank into bottle by ARS agricultural engineer Robert Rice. Sample will be used for soil column studies at U. S. Water Conservation lab to determine disposition of nitrogen and oxygen requirements. The tank is an overflow structure that maintains constant pressure in flume supply lines (1069Z39–10). ***Left:*** *Technician E. D. Escarcega adjusts in-flow of effluent into recharge basin as Bouwer checks flow rate on water stage recorder (1069Z40–20).*

Left: Bouwer operates electrical analog to determine the properties of ground water reservoirs. He also used analog to design the prospective system for Phoenix area (1069Z41–13).

Right: Escarcega measures water pressure with tensiometer. Device tells where clogging occurs, how fast soil drains when basin is dry, and how long it takes inundation to rewet basin (1069Z42–1).





consists of six parallel recharge basins 20- by 70-feet each.

The grass eliminates some of the suspended matter and at the same time, shades the bottom, cutting down on algal growth. It also provides an anchoring place for aerobic bacteria (active in the presence of oxygen) that digest organic substances in the water.

Under the aerobic conditions at the beginning of the inundation period, micro-organisms oxidize the ammonium (NH_4) in the effluent to nitrate (NO_3). When all of the oxygen has been consumed by the aerobic micro-organisms and the grass roots, anaerobic (no free oxygen present) conditions set in and bring on the denitrifying activity. Under those conditions, certain micro-organisms get the oxygen for their metabolism from the nitrate, forming nitrogen gas which escapes to the atmosphere.

ARS hydraulic engineer Herman Bouwer, who is directing the project, says that 90 percent of the nitrogen can be removed from the effluent during alternate cycles of 14 days wet, 10 days dry. The dry-up period serves two purposes—(1) it restores the infiltration rate which drops during a long inundation period due to soil clogging and (2) it brings oxygen into the soil profile to aid in nitrification and digestion of organic material.

Bouwer and coworkers have found that basins seeded with common Bermudagrass more effectively remove nitrogen than do ungrassed plots. Although plant uptake of nitrogen as a nutrient has little to do with its removal, the plants may add more organic material to the water for use by denitrifying micro-organisms under anaerobic conditions. Also, consumption of oxygen by plant roots could speed the onset of anaerobic conditions necessary for nitrogen removal.

About 90 percent of the phosphorous is removed by adsorption to soil particles or by precipitation into the soil profile.

The biochemical oxygen demand in raw sewage runs about 200 ppm. Secondary sewage carries about 20 ppm, while plant-soil filters clean the secondary sewage to about 0.2 ppm—as clean as most ground water and unpolluted stream water.

Although most of the fecal colliform bacteria and viruses in the effluent die out while traveling vertically through the first 5 to 10 feet of soil, Bouwer suggests that pumps be placed at least 500 feet from the basins to make certain the water is usable. It should take

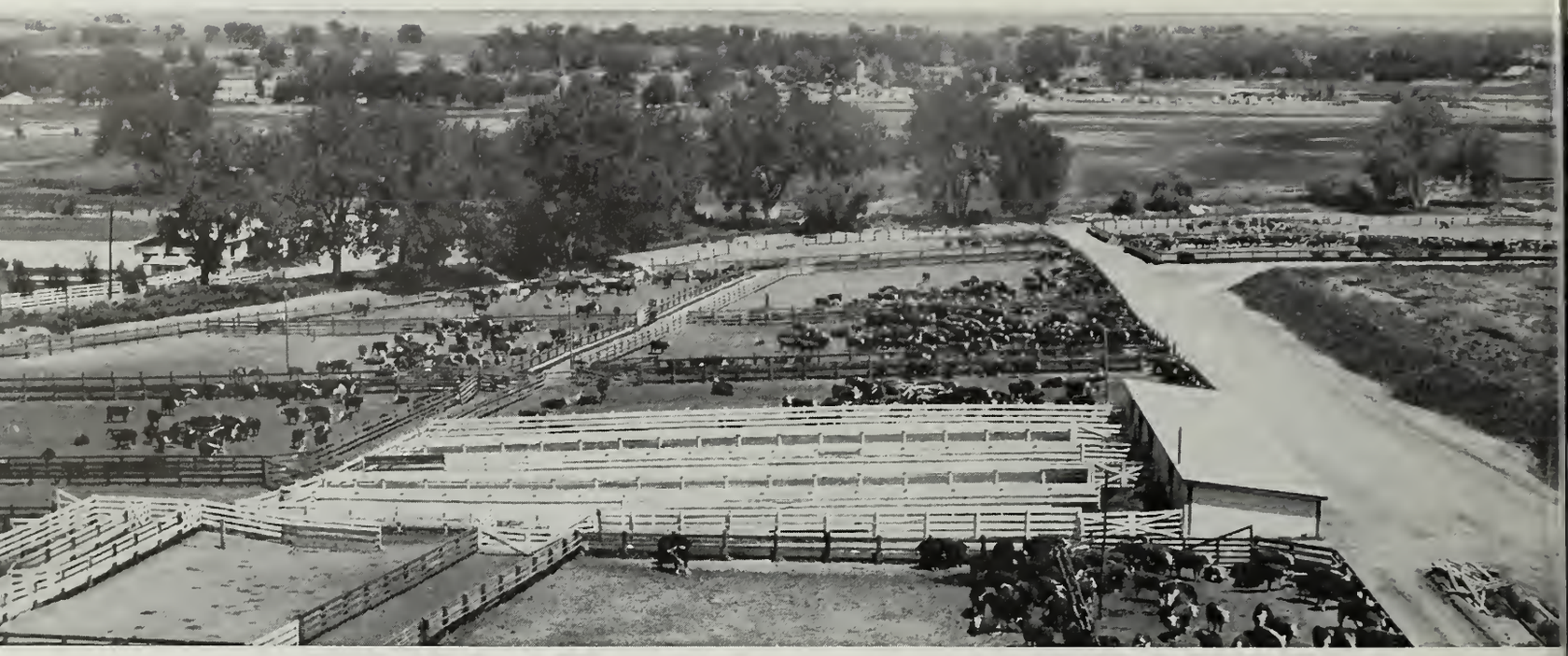
at least a month for the water to travel from the basins to the pump. This time and distance of underground travel is also desirable for improving taste and odor, Bouwer says.

Along with optimum design and management, other criteria necessary for the proper functioning of recharge basins are that the water table below the recharge basins be at least 5 feet deep and that precautions be taken to minimize the spread of reclaimed water into the aquifer.

Ultimately, salt may be a problem with reclaimed water. Each time the water goes through a cycle of domestic use it picks up about 300 ppm salt. Water in the Phoenix area starts out at about 600 ppm. When the salt content reaches 1,000–1,500 ppm after several cycles of use, it will probably have to be blended with other "fresh" water or desalinized. ■

Above: *Clarence Lance takes air samples for analysis from columns filled with soil from recharge basins. Analysis will determine how much oxygen is needed by bacteria to decompose organic wastes (1069Z41–34).*

Below: *Bouwer demonstrates fine texture of sand in Salt River bed. Sand goes down 3 feet; coarse sand and gravel go 250 feet deeper—an ideal combination for recharge basin studies (1069Z39–19).*



fertilizers & feedlots
. . .what role in groundwater pollution?

No significant contamination of the water table with nitrate from farm fertilizers or extensive cattle-feeding operations was found in preliminary ARS studies in northeastern Colorado.

But the studies indicated that substantial amounts of nitrate could eventually reach the water table under heavily fertilized irrigated fields and under feedlots.

Much additional research is needed to define the conditions under which nitrogen fertilization and percolation from feedlots may constitute a pollution hazard and to find ways for disposing of animal wastes safely. ARS studies are underway in Colorado, Georgia, Maryland, Nebraska, Pennsylvania, and Texas.

Nitrate content can influence the suitability of ground water for household use. Nitrate can be converted to nitrite, which under certain conditions, can reduce the oxygen-carrying capacity of red blood cells in infants. Adults are seldom affected. The Public Health Service has set 10 parts per million as the maximum desirable limit for nitrate-nitrogen in drinking water.

ARS soil scientists B. A. Stewart, F. G. Viets, G. L. Hutchinson and W. D. Kemper measured nitrates in 129 soil cores drilled to bedrock or the water table and in 75 samples of ground water taken with the cores in Colorado's South Platte River Valley. The Colorado Agricultural Experiment Station cooperated.

The irrigated part of the valley is intensively farmed, and its feedlots handle more than 600,000 cattle at one time. Use of commercial fertilizer in Colorado has increased five-fold in the past decade but is not excessive in terms of crop needs. Nonirrigated fields and rangelands in the valley where cores were taken have never received nitrogen fertilizer.

The investigators found that, on the average, the kind of land use did not affect the nitrate concentration of water entering the bottom of the holes where the cores were taken.

Even under the same kind of land use, the composition of the water was highly variable. Nitrate-nitrogen in ground water samples from beneath feedlots, regularly fertilized irrigated fields, cultivated dryland, and native rangeland varied from none to more than 10 ppm.

The scientists emphasize that their samples came from the surface of the water table and may not represent what is pumped from a well that taps several to many feet of a water-bearing stratum. The surface may contain more pollutants than water deeper in the aquifer.

Although the nitrate content of soil cores taken under sites with the same land use was also extremely variable, land use did influence the nitrates under the various sites. Average total nitrate-nitrogen (pounds per acre) in 20-foot cores was:

Irrigated alfalfa	79
Native grassland	90
Nonirrigated cropland	261
Irrigated cropland not alfalfa	506
Feedlots	1,436

The low reading under alfalfa was expected. Its roots can remove nitrates from deep in the soil, and it is rarely fertilized with nitrogen since nodules on its roots utilize free nitrogen from the air.

The nitrates in cores taken from nonirrigated crop and rangeland probably result from normal decomposition of organic matter and natural deposits in these soils, and not from man's activities.

The researchers say nitrate accumulation in soil, amount of water moving through the soil, and hydraulic characteristics of the aquifer determine ground water pollution.

In the semiarid South Platte Valley, only 1 to 4 inches of water move downward annually. Of the 506 pounds per acre of nitrate-nitrogen in the soil of irrigated fields not in alfalfa, scientists estimate only 25 to 30 pounds reach the water table each year. Whether this amount produces serious contamination depends on the size of the aquifer, where its water comes from and goes, and how rapidly aquifer water is exchanged.

Despite the high nitrate concentration under feedlots, scientists believe the contribution of these areas to ground water pollution is not great.

Feedlots occupy a relatively small part of the total area, and some breakdown of nitrate probably occurs above the water table in most feedlots. The scientists attribute this to deep percolation of soluble carbon compounds capable of supporting micro-organisms that release nitrogen by denitrification. Farmstead wells near feedlots are most likely to be polluted, but the offensive odor of the water is a warning that nitrates may be present. ■

Identifying Mycoplasma . . . quickly

A RELIABLE METHOD for rapidly identifying Mycoplasma strains is being perfected by Israeli scientists under a Public Law 480 foreign currency grant from ARS.

The Israeli work will substantially advance immunologic studies of the numerous strains of Mycoplasma, previously known as PPLO (pleuropneumonia-like organisms), which are known to cause pneumonia in man and other mammals, mastitis in cattle, infectious sinusitis in turkeys, and chronic respiratory disease in chickens. In addition, various Mycoplasma species have been isolated from body fluids and tissues of humans affected with various diseases, including certain genetic disorders. Mycoplasma are classified somewhere among bacteria, the rickettsiae, and viral organisms.

Some of the Mycoplasma strains studied by the Israelis were within the species *Mycoplasma mycoides* var. *mycoides*, the cause of contagious bovine pleuropneumonia. This work for USDA could only be done overseas because Federal quarantine regulations forbid the importation of *M. mycoides* cultures. A highly infectious disease, bovine pleuropneumonia has been eradicated in North America but remains a constant threat.

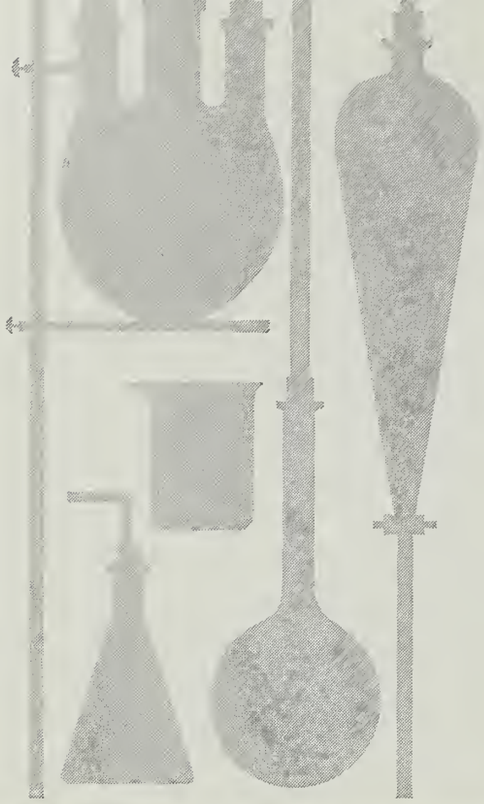
In the past, Mycoplasma strains were identified through a time-consuming probe of the entire organisms. The Israelis compressed the time required by concentrating on the Mycoplasma cell membrane. They found that this thin covering, which forms over 30 percent of the total cell mass, contains all the necessary biological codes for characterization of different species and strains within species.

The Israelis gently ruptured the micro-organisms, taking only the cell membrane for study. This is analogous to investigating the metabolic secrets of an egg by studying only the fragments of its shell.

The researchers took the membrane apart with detergents, and in one group of experiments subjected the soluble and membrane-bound Mycoplasma proteins to electrophoretic studies. In electrophoresis, particles suspended in a liquid migrate by electromotive force to specific electrodes; in so doing, the particles form identifiable bands or patterns of varying densities and widths.

The Israelis proved that these different protein patterns could be infallibly matched to specific species. This identification procedure is so efficient that less than 1 milligram of cell protein is required for the test.

Shmuel Razin is the principal investigator for this 4-year project, begun in 1965 at the Hebrew University, Jerusalem. The ARS sponsoring scientist is O. L. Osteen, Beltsville, Md. ■



AGRISEARCH NOTES

House Fly Pupae . . . for Feed?

House fly pupae could be an acceptable protein source when substituted for soybean meal in chick feed.

Day-old chicks fed dried, ground fly pupae as a source of protein grew at a rate equal to that of control chicks fed soybean meal. ARS poultry nutritionists C. C. Calvert and R. D. Martin and entomologist N. O. Morgan conducted the research at Beltsville, Md. The researchers say that rearing the pupae on poultry manure could provide a way to convert the manure into useable high-quality protein.

In the tests, fly pupae from a laboratory colony were frozen and then dried in a forced air oven. After drying, they were ground and mixed with cellulose to adjust the protein content from 63.1 down to 50 percent—the same percentage protein as the soybean meal.

Two diets were fed to the chicks; regular chick starter ration, or the same ration with the fly pupae substituted for soybean meal as the source of protein in the feed.

In phase one of the experiment, all chicks were fed regular chick starter for the first week. Then, half of the chicks were continued on the regular ration while the other half were fed the experimental ration for a week. In the second phase of the experiment, half of another group of chicks were fed the regular and half the experimental ration for the entire two weeks. Chicks in all the tests grew equally well.

Warm Soil Improves Peanut Stand

For good seedling emergence, soil temperature at peanut planting time should average 65° F. or higher at 4-inch depth. Planting peanut seed in cool soil reduces stand.

The date when the mean soil temperature (average of daily maximum and minimum) had averaged 65° F. for 10 days ranged from March 8 to April 13 at three Alabama locations over a 5-year period. The study was conducted at Auburn, Ala., by agronomists A. C. Mixon of ARS and E. M. Evans of the Alabama Agricultural Experiment Station and meteorologist P. A. Mott of the U.S. Weather Bureau.

If growers cannot obtain daily soil temperature readings from the local Weather Bureau office, they can insert a reliable thermometer 4 inches into the soil at several locations in the field and take readings about 10 a.m. on a clear day. The average of the readings should approximate the daily average soil temperature in the field.

Salt Helps Gage Stream Velocity

Common table salt is helping measure water velocities in stream channels.

The cheap, effective salt-tracing method—an offshoot of techniques using expensive fluorescent dyes or radioisotopes—is ideal for small mountain streams where light portable equipment is a necessity.

The method is not only inexpensive, quick, and easy, it also employs equipment already available at many experimental watershed and water resources centers.

One person, even in stormy weather in rough terrain, can measure stream velocity with the aid of a pH meter (measures ion activity) equipped with a sodium ion probe.

About a half pound of salt is dissolved in 3 gallons of stream water, injected into the center of the stream, and measured downstream by the pH meter. A time-concentration graph is constructed from the meter readings and, through the use of equations, the stream velocity in feet per second is obtained. The amount of salt used is so small that pollution is negligible.

Channel velocities are important to hydrologists developing flood routing techniques in such channels and are also used, among other things, in developing mathematical (computer) models for predicting runoff from mountainous watersheds.

ARS research associates D. J. Calkins and Thomas Dunne, Sleepers River Research Watershed, Danville, Vt., report that the salt-tracing technique provides a better estimation of channel velocities in mountainous streams than existing stream velocity measuring methods.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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